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## **Rapporteur's Report on Conservation Agriculture**

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The negative externalities of intensive agriculture to natural resources and environment are becoming increasingly apparent. Specifically, the intensive agriculture has given rise to problems like soil salinity, soil erosion, devastation of soil structure, water pollution, depletion of ground water resources, increasing pest resistance, loss of biodiversity, outbreak of secondary pests and secondary effects on human health. All these manifest in slowing down the yield growth and decline in profitability of agriculture, which not only have an adverse impact on farm incomes, but may also have adverse consequences for food security in the long run.

Conservation agriculture (CA) is claimed to be a viable option for sustainable agriculture, and is being practiced in many developed and developing countries. CA has been identified as one of the technological options to meet the global challenges of increasing food production and conserving environment under the Millennium Development Goals (MDGs) by United Nations. Defined broadly, conservation agriculture is a resource saving technology/method and refers to the system of raising crops without tilling the soil, while retaining crop residues on soil surface, and involving spatial and temporal crop sequencing/rotations. Thus, it is based on the principle of minimum soil disturbance and thus promotes natural biological processes above and below the soil surface.

The concept of Conservation Agriculture is relatively new to India. The CA, mainly zero tillage and bed planting is largely practiced in the Indo-Gangetic Plains (IGPs) on an estimated 2-3 million ha. Consequently, most of the literature related to CA is largely confined to the rice-wheat system of the Indo-Gangetic plains. The CA has been reported to reduce cost of production while improving yield and conserving land and water resources (Abrol *et al.*, 2000; Ekboir, 2002; Sharma *et al.*, 2004; Singh, 2008). With such benefits in consideration, CA with some modification is also being promoted in different agro-ecological regions including rainfed regions. This indicates that there is an opportunity to enhance farm profitability and improve sustainability of agriculture in the resource poor regions through application of the principles of CA.

A total of 19 papers were received for discussion under this theme. Most papers however deal with adoption of CA and the factors influencing adoption, and returns from adoption of CA vis-à-vis conventional farming. A few papers also highlight the environmental benefits resulting from adoption of CA. One paper estimates

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reduction in carbon emissions due to CA and its implications for carbon credits. Most papers discuss policy and institutional issues in making CA work, but lack an in-depth probing. Though largely confined to irrigated agriculture, particularly rice-wheat systems, a number of papers examine applicability of CA (with some modifications) to rainfed regions and salt affected areas. The salient findings of the papers received under this theme are briefly discussed below under different heads:

### *Water Conservation*

Water is a scarce resource. Hence its conservation is critical to enhance agricultural production. Paddy is the most water-consuming crop, and several technologies are being experimented to improve water use efficiency. P. Samal *et al.*, have examined the extent of water saving through alternative wetting and drying (AWD) technology in Orissa (Cuttack and Jajpur districts). The field testing revealed that two to three irrigations could be saved due to adoption of AWD along with new rice varieties. If adopted on a large scale the water so saved can be used to irrigate additional 3 million ha of rice. Besides, the unit cost of production could be reduced by Rs. 375/tonne of rice. Widespread adoption of AWD, however, requires collective action to manage water. In an another paper V.K. Choudhary and K.K. Choudhary have documented higher net returns from system of rice intensification (SRI) in Chhattisgarh as compared to conventional methods. Under SRI resource efficiency of land, labour, capital, and water were also higher. Yields reported under both the systems were however considerably higher than the state average yields.

### *Soils Degradation and Salinity*

Soil salinity and soil degradation is increasing at a fast pace in several irrigated areas leading to loss in production and productivity. Reclamation of saline lands is an option but involves huge investments. V.B. Jugale in his paper highlighted soil salinity in the sugarcane growing belt of Maharashtra leading to continuous decline in yields. The paper has tried to identify the causes of salinisation, estimate economic loss due to salinisation, and economic cost of de-salinisation. The main causes of salinisation identified include a lack of natural drainage, and excessive use of water and chemical fertilisers. The paper has highlighted various dimensions of loss due to salinity: direct loss of productivity, loss of opportunity cost, loss in land value, loss of labour hours, and wastage of water. The cost of de-salinisation was high and recurring expenditure was required over 3-4 years without expecting any returns from land. Collective action, group credit, government support are required to ensure that de-salinisation is made possible. Although, the benefits of de-salinisation in terms of yield increase and cropping pattern change are reported it is not clear how long it would take to recover the initial investment cost.

The paper by R.N. Burman and R. Das has brought out the factors affecting soil and water conservation efforts by farmers in north bank plains zone of Assam using Tobit model. They have identified large family size, perception towards profitability of conservation methods, and perception on effects of soil erosion on crop yields positively influencing investment into conservation practices while off farm employment and land tenure system had a negative impact on investment decisions.

Arimardan Singh *et al.*, attempt to quantify the economic loss due to water logging and salinity in north-western region of India (Uttar Pradesh) in the case of paddy and wheat. The income loss per hectare increased with higher level of salinity. Farmers' strategies (raised bunds, *kharif* fallowing, more farm yard manure, scrape salts) for overcoming impact of salinity on yields were highlighted. Sub-surface drainage is the best option to permanently solve the drainage problem. Since this requires high initial investment and takes several years as a short term measure, farmers should practice proper use of irrigation water and surface drainage improvement.

### *Organic Farming*

Though not a CA technology, organic farming is a form of conservation agriculture where the use of external inputs (chemicals and inorganic fertilisers) is virtually eliminated. In the study of organic farming in Chhattisgarh, A.K. Gauraha and M.R. Chandrakar highlight that lower production in the initial years due to organic farming is compensated by higher production in the later years. Organic produce fetches higher prices, and the study suggests identification of organic farming zones, training in organic farming practices, certification, setting up an Organic Agriculture Research Institute and linking organic farmers to niche markets to promote organic farming. In another paper P. Indira Devi *et al.*, have focused mainly on organic farming/non-chemical based technologies for paddy and banana in the humid tropical regions of Kerala. They also documented farmers' experiences in application of Integrated Pest Management (IPM), and suggest training in local production of organic inputs and scientific monitoring system for quality control of commercial organic inputs.

### *Carbon Emissions and Credits*

Agriculture contributes about 10-12 per cent to green house gases (GHGs) emission. This can be reduced through crop management and agronomic practices. O.P. Singh *et al.*, scaled up the benefits of resource conservation technologies (RCTs) in major wheat growing regions of India in terms of reduction in carbon emissions, improvement in soil health, and savings due to reduced fuel and fertiliser consumption. Using various scenarios on adoption of RCTs they quantified their environmental benefits. The estimated reduction in diesel consumption due to RCTs

and consequent reductions in GHGs were based on data available in the literature. Although reductions in emissions are converted into carbon credits it is not clear how farmers will benefit from the credits. Since RCTs involve incremental costs, a clean investment grant for RCT to succeed is recommended.

### *Conservation Agriculture in Rainfed Regions*

Conservation agriculture is less common in rainfed areas though it is being applied there with some modifications. K.N.S. Banafar and Ranveer Singh focused on soil and water conservation, cropping pattern and watershed management in Raipur district of Chhattisgarh. Due to watersheds, area under crops increased in both *kharif* and *rabi* seasons but more so in *rabi* season. Per farm income also increased during post-project period. Paddy remained the main source of income despite introduction of new crops. The study also highlighted increase in employment opportunities in the non-farm sector which is attributed to urbanisation? Likewise, income from livestock seems to have decreased? These findings need to be revisited.

In their paper Shalander Kumar *et al.*, provides an overview of conservation technologies for dryland agriculture. The study point out that some of the conservation agriculture techniques need to be adapted to rainfed agriculture. For example, minimum tillage with residue retention on surface is more appropriate than zero tillage in rainfed agriculture. However, the CA techniques will have to be followed over a longer term. Non-adoption of conservation practices/NRM technologies was mainly due to the lack of proper institutional and policy support. Uttam Bhattacharya and K.K. Dutta also focuses on rainfed agriculture with some reference to SRI with limited irrigation. They also emphasised conservation tillage with residue retention on surface as more appropriate than zero tillage. However, the challenge is to find alternative strategies of meeting fodder requirements for livestock.

M.N. Waghmare *et al.*, examines the impact of mulching on groundnut production in Maharashtra and found that the farmers adopting this technology could get about 50 per cent higher yield and gross returns. The technology was found to be more beneficial to the groundnut crop grown under rainfed conditions.

### *Conservation Agriculture in Irrigated Farming*

Ram Singh *et al.*, find zero tillage more profitable than the conventional in the Indo-Gangetic plains. There is also a significant reduction in cost (machine, labour and irrigation costs). However, the paper did not quantify the contribution of zero tillage towards environmental sustainability.

A. Narayanamoorthy makes a case for drip irrigation to be a component of conservation agriculture since it contributes to saving of resources such as irrigation, water and electricity while enhancing productivity. Benefit-cost analysis indicated

that drip irrigation was viable even without government subsidy. The findings were based on studies carried out by the author in Maharashtra on sugarcane, grapes, banana, and cotton. The author's computation indicates that farmers can recover the entire capital cost of the drip set from their net profits in the first year itself. However, the environmental benefits related to land and water pollution due to drip irrigation are not clearly specified.

R.S. Sidhu *et al.*, look at various conservation methods (laser leveler, permanent raised beds, tension-meters in rice, direct seeding of rice) besides IPM, protective technologies in vegetable cultivation, and diversification of agriculture as possible strategies for conserving resources and promoting sustainable agriculture in Punjab. They used primary and secondary data from various sources and found that all the conservation technologies are technically feasible and economically viable. However, it does not spell out cost implications of various technologies. To improve the adoption of conservation technologies, hiring services for machinery should be available to farmers as well as strengthening the value chain system for maize pulses, oilseeds, and milk and milk products.

In their paper Anil Kumar Sachan and others examine the benefits of adoption of zero-tillage in farmers' fields in Uttar Pradesh, Bihar and Haryana and also identify the factors influencing its adoption for wheat in rice-wheat systems. The on-farm economic benefits of zero-tillage included savings in diesel, tractor use, and cost of seeds. Yield increase, however, was not very significant. Years of farming experience, exposure to mass media, government programs, and availability of credit were important factors influencing the uptake of resource conservation technologies. The authors concluded that timely availability of zero tillage machines through market services would help speed up adoption.

D. Tata Rao provides an excellent background on conservation agriculture. The paper was based on review of literature and author's perceptions of conservation agriculture. It focused on the definition of conservation agriculture, constraints of and factors that influence the adoption of conservation agriculture. Likewise the paper by Ramakrishna Rayavarapu is also a review paper on CA and goes on to suggest appropriate institutional arrangements like hire services, farmers' associations would help in involving small farmers in adoption of CA.

#### ISSUES FOR DISCUSSION

- FAO (2010) defines Conservation Agriculture as 'a concept for resource saving agricultural crop production that strives to achieve acceptable profits with high and sustained production level while concurrently conserving the environment'. However, most of the papers received look at conservation agriculture from various angles. The issue here is should the definition of Conservation Agriculture be broadened beyond experimental/scientific definition to reflect the ground reality.

- At present conservation agriculture in India is practiced mainly in the irrigated areas. Some papers have highlighted its application in rainfed and other agro-ecological environments. What is the scope for extending Conservation Agriculture in its present or modified form in different agricultural environments especially in rainfed agriculture and humid tropics?
- What are the potential social, economic and environmental impacts of conservation agriculture at micro level and scaling up and out of these impacts at meso and macro level? (Returns to investment in CA)
- What constrains adoption of conservation agriculture? What social, economic, institutional and policy measures (subsidies, credit access, farmer collective action and capacity building, public-private partnership, fine tuning of equipment like zero-tillage etc.) are needed to overcome these in the process of its scaling-out?
- What is the scope and limitations of earning carbon credits to benefit the farmers — how and to what extent?

#### REFERENCES

- Abrol, I.P., K.F. Bronson, J.M. Duxbury and R.K. Gupta (Eds.) (2000), *Long-Term Soil Fertility Experiments in Rice-Wheat Cropping Systems*, Consortium Paper Series 6, Rice-Wheat Consortium for the Indo-Gangetic Plains, New Delhi, India.
- Ekboir, J. (Ed.) (2002), *CIMMYT 2000-2001 World Wheat Overview and Outlook: Developing No-Till Packages for Small-Scale Farmers*, CIMMYT, Mexico, DF.
- Sharma, R.K., R.S. Chhokar and D.S. Chauhan (2004), "Zero-Tillage Technology in Rice-Wheat System-Retrospect and Prospects", *India Farming*, Vol.54, No.4, pp. 12-17.
- Singh, N.P. (2008), *Adoption and Impact of Resource Conserving Technologies on Farm Economy in Indo Gangetic Plains, India, Agricultural Economics*, Research Report 2008-01, Division of Agricultural Economics, Indian Agricultural Research Institute, New Delhi.